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International Earth Science Constellation Mission Operations Working Group

April 13-15, 2016

Constellation Coordination System (CCS) Status

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Agenda

- CCS in the Present
 - CCS Purpose
 - CCS 7.1
 - Migration to Microsoft Server 2008
- CCS in the Future
 - CCS 7.2
 - CCS 7.3+
 - CCS Security

CCS in the Present

CCS Purpose

- System for coordinating and monitoring Constellation safety of the Earth Sciences Constellation (ESC) missions and is a central source of data sharing and operational planning
 - Primary tool for monitoring the Constellation configurations
 - Enables information exchange among/between domestic and international partner ESC missions, including access to 7-day mission ephemerides
 - Transfer critical product data between the Mission Operation Centers (MOCs), CARA, and other authorized mission users
 - Mission Analysis tools and automated health and safety monitoring
 - Automated constellation safety warning notifications
 - Graphical visualization of orbital data
- The latest release, CCS 7.1, was deployed to operations on December 14, 2015

CCS 7.1

- The home page provides users with the status of the missions, including user input status flags for the satellite, instrument, and constellation.

Status Flags

EOS Afternoon Constellation

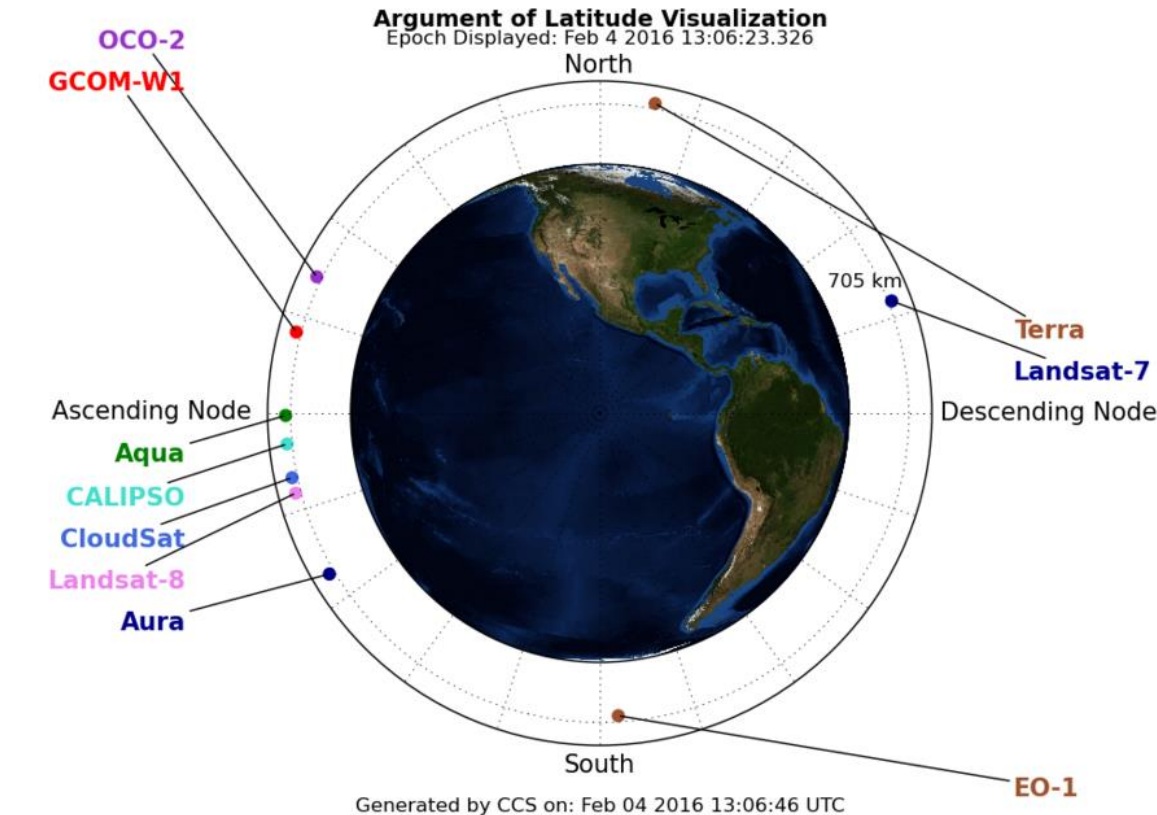
Categories	Aura	CALIPSO	CloudSat	Aqua	GCOM-W1	OCO-2
Satellite	Green	Yellow	Green	Green	Green	Green
Instrument	Yellow	Yellow	Green	Green	Green	Green
Constellation	Green	Green	Green	Green	Green	Green

EOS Morning Constellation

Categories	Landsat-8	Landsat-7	Terra	EO-1
Satellite	Green	Green	Green	Green
Instrument	Green	Green	Green	Green
Constellation	Green	Green	Green	Green

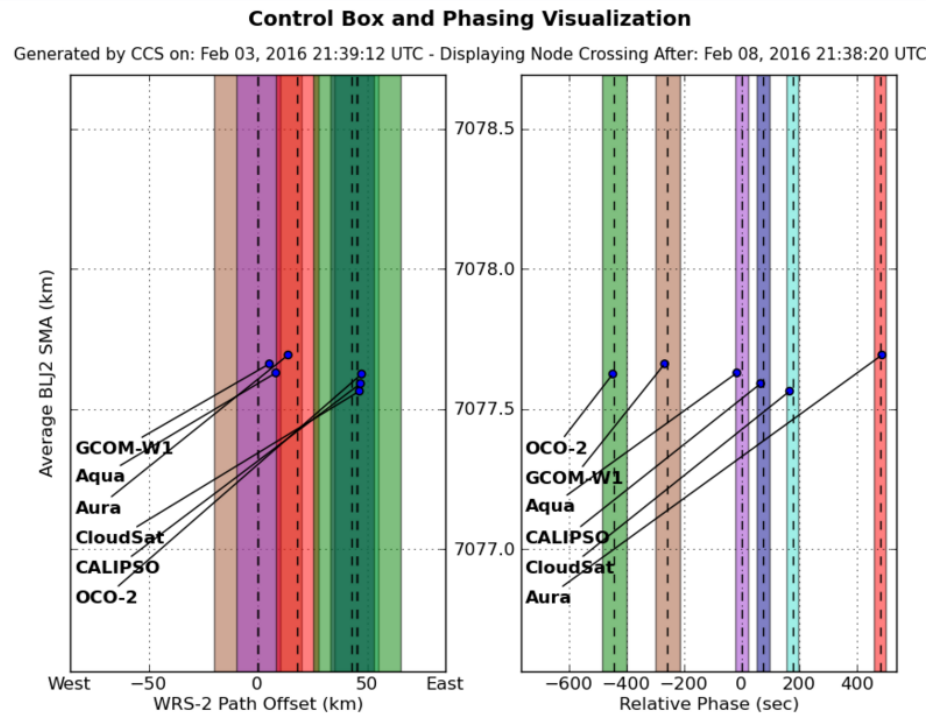
CCS 7.1

- Home page plots visualize near-current orbital parameters for each mission in the constellation using the most recently acquired predicted ephemerides



CCS 7.1

- CCS utilizes the latest ephemerides from each mission member to detect control box violations
 - If a violation is detected, CCS distributes emails with predicted control box exit and reentry dates along with other pertinent information to constellation members



CCS 7.1

- Product files can be downloaded directly from CCS or delivered to the user via subscriptions

Current Product Rule [Select a different Product Rule](#)

Product Rule Name	Rule Type	File Format	File Template
Aqua - Ephemeris - Predicted (STK3 format)	Acquisition	STK 3.0 Ephemeris	PM_EOSEPHM<n>_<ddd>_<yyyy>_<vv>.e

Select a Product File

Product File Name	Created ↓	Processed	Native	Start Date	End Date
PM_EOSEPHM1_035_2016_01.e	2016-02-03 20:13 UTC	Yes	Yes	2016-02-04 00:00 UTC	2016-02-11 00:00 UTC
PM_EOSEPHM1_034_2016_01.e	2016-02-02 20:13 UTC	Yes	Yes	2016-02-03 00:00 UTC	2016-02-10 00:00 UTC
PM_EOSEPHM1_033_2016_01.e	2016-02-01 20:13 UTC	Yes	Yes	2016-02-02 00:00 UTC	2016-02-09 00:00 UTC

CCS 7.1

- Subscriptions to products can be easily created, allowing a user to have the product files delivered via email and/or SFTP.
- Users can manage all aspects of their product subscriptions from a single location

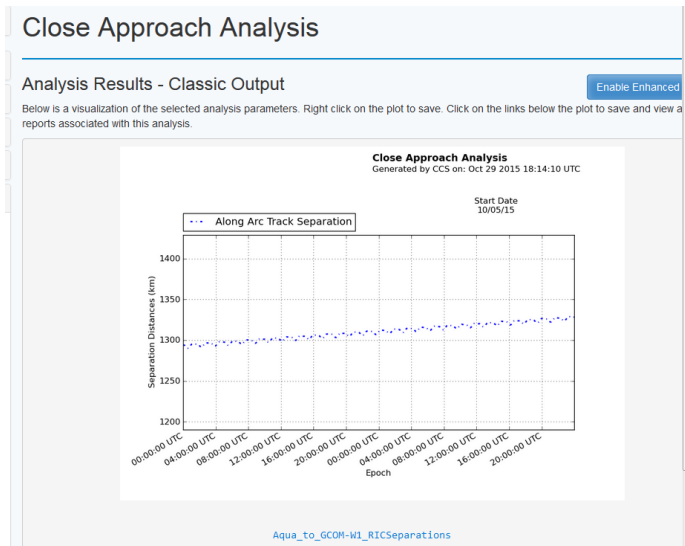
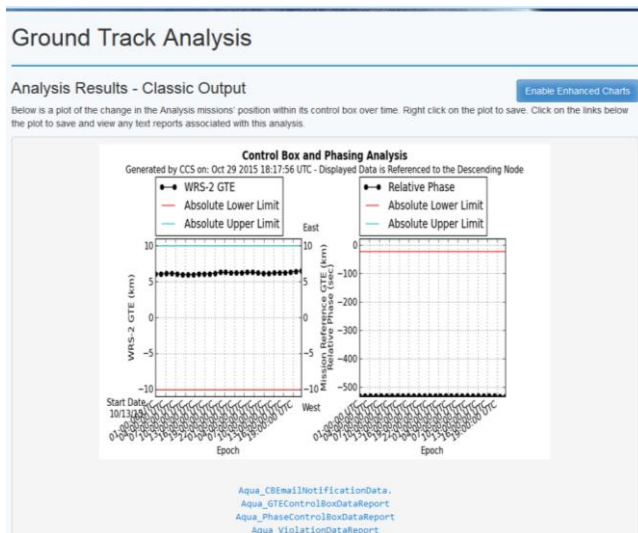
[Create New Subscription](#)

Modify Existing Product Subscriptions

Active	Mission ↑	Product Rule	
<input type="button" value="No"/> <input type="button" value="Yes"/>	Aqua	Aqua - Ephemeris - Predicted (STK3 format)	<input type="button" value="Transfer"/> <input type="button" value="Edit"/> <input type="button" value="Delete"/>
<input type="button" value="No"/> <input type="button" value="Yes"/>	Aura	Aura - Ephemeris - Predicted (STK format)	<input type="button" value="Transfer"/> <input type="button" value="Edit"/> <input type="button" value="Delete"/>
<input type="button" value="No"/> <input type="button" value="Yes"/>	CALIPSO	CALIPSO - Predicted Ephemeris Converted to STK	<input type="button" value="Transfer"/> <input type="button" value="Edit"/> <input type="button" value="Delete"/>
<input type="button" value="No"/> <input type="button" value="Yes"/>	CloudSat	CloudSat - Predicted Ephemeris (Converted to STK3)	<input type="button" value="Transfer"/> <input type="button" value="Edit"/> <input type="button" value="Delete"/>

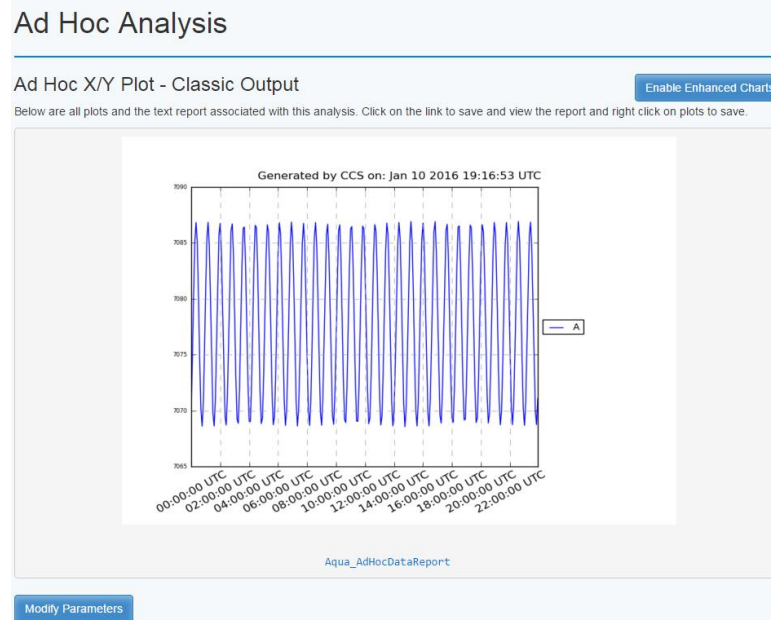
CCS 7.1

- CCS contains a collection of tools useful for quick analysis including ground track error and relative phasing, mean local time of the nodes, close approach analysis, and ad-hoc generation of orbital parameter reports and plots
- Results of tool executions can be saved and shared with other CCS members



CCS 7.1

- Some of the enhancements released in CCS 7.1 include:
 - The capability to use CCSDS OEM ephemeris files in analyses
 - Improvements in email notifications, including standardizing the email format, adding additional email types, and delivering emails to all of the relevant recipients
 - Quicker loading of the product subscription page
 - Improved ability to re-run an analysis with the “Modify Parameters” button on the Results page

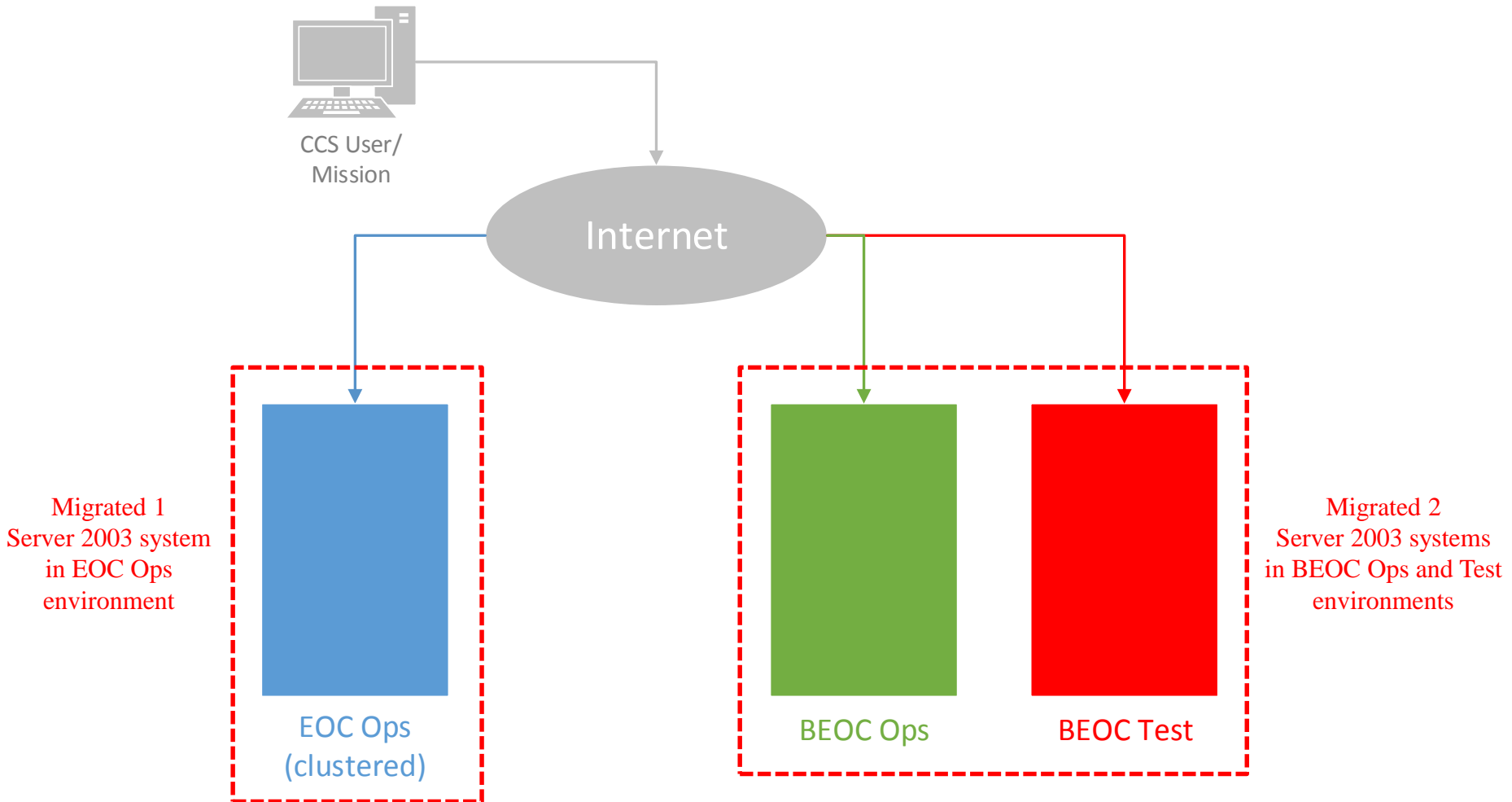


Migration to Microsoft Server 2008

- Identified 3 servers across the CCS prime (EOC) and backup (BEOC) environments that required migration due to Microsoft Server 2003 reaching end of life
 - Required issuing new IP addresses to 14 CCS servers
 - Affected mission interfaces with CCS servers
- Planned/coordinated CCS migration with international partner agencies, other NASA centers, and user community
- During migration, identified and deployed security-related improvements to internal CCS traffic
- All Microsoft Server 2003 systems were powered down and removed from the network in accordance with our schedule

*Thanks to all of the missions for their help in
making this critical project a success!*

Migration to Microsoft Server 2008



This network diagram has been simplified for security purposes.



Mission Operations Working Group

April 13-15, 2016



CCS in the Future

CCS in the Future

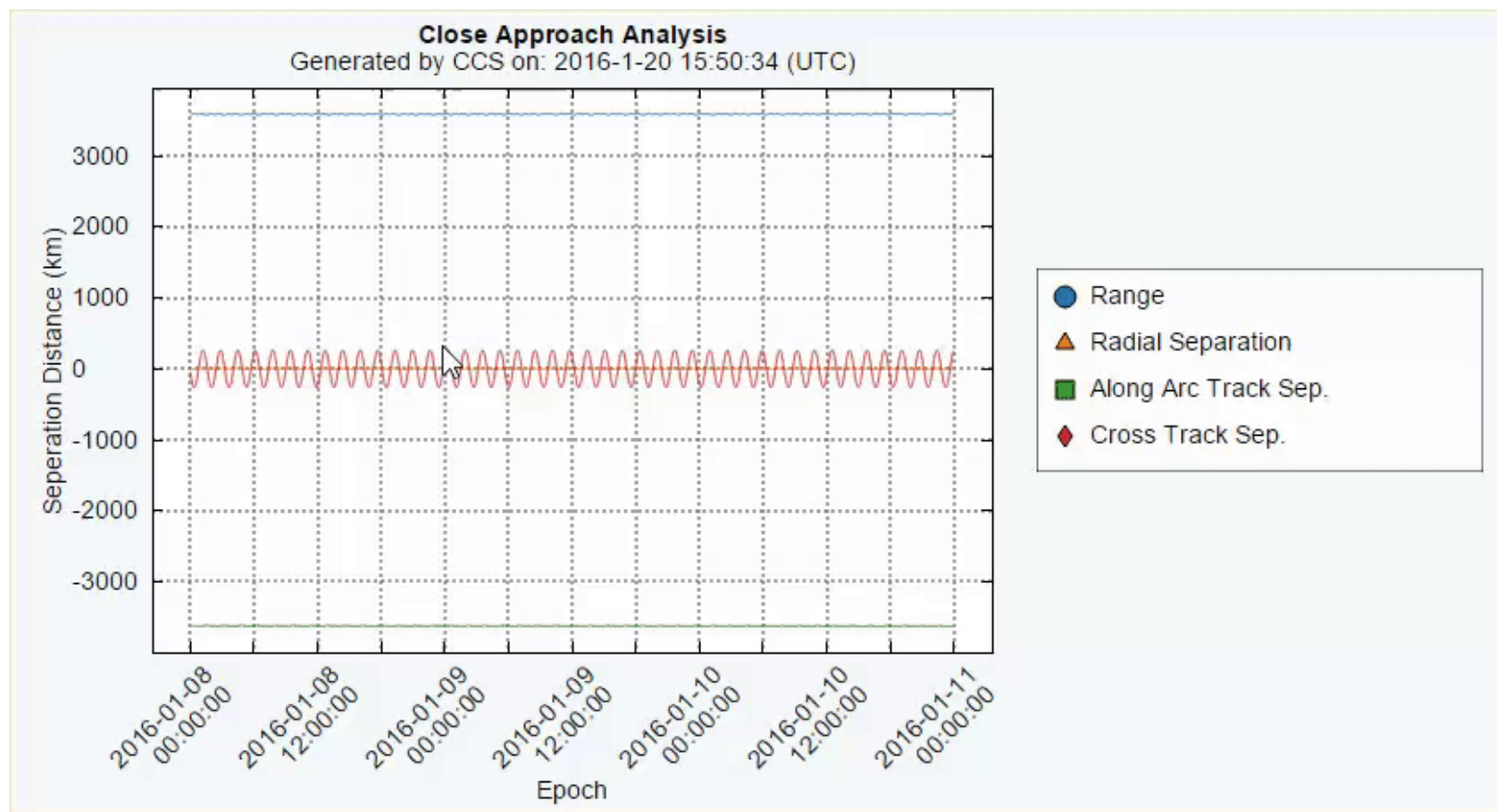
- The long term goals for CCS are:
 - Enhance CCS capabilities as an online tool that performs flight dynamics analyses relevant to the Morning/Afternoon Constellations
 - Will be accomplished by targeting improvements to CCS in future releases to contain functionality that users have asked for and by soliciting user feedback more frequently
 - Make CCS more secure to better protect each mission's data
 - Will be accomplished through the use of RSA token for two-factor authentication for user login to the website, and by implementing password complexity and password cycling changes

CCS 7.2

- CCS 7.2 is currently in development, and is scheduled for deployment in Q3 2016
- Some of the features to be included in CCS 7.2 are:
 - Upgraded plots: Classic and enhanced plots will be replaced by a single set of interactive plots containing the following capabilities:
 - Left-click and drag zoom
 - Right-click context menu containing options to zoom out, reset zoom, reload image to its initial state, save the plot as a .PNG image, and save all plots as a zipped file of .PNG files
 - Show/hide data series by clicking on the data series in the legend
 - Highlight data series upon mouse-over of the data series in the legend
 - Display of a tooltip containing the parameters of a data point upon mouse-over of that data point in the plot
 - Display of a tooltip containing the name of the input ephemeris of a data series upon mouse-over of that series in the legend

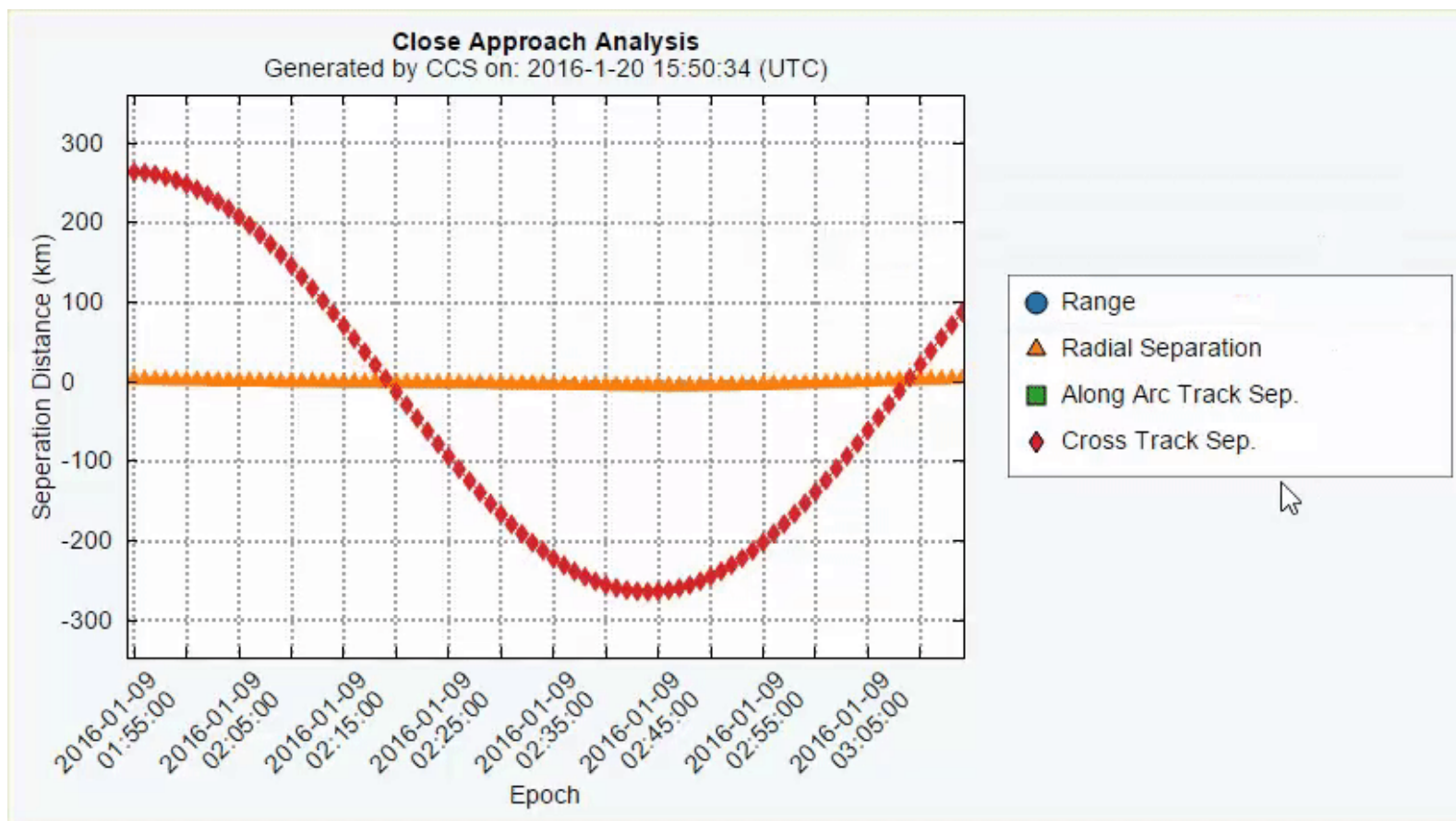
CCS 7.2

- Zoom in/zoom out/reset zoom



CCS 7.2

- Legend tool tip, series show/hide



CCS 7.2

– Other Enhancements:

- Improvements in Control Box Violation emails to ensure that the same information is not sent more than once
- Delivery of Control Box Violation and Constellation Close Approach emails to all ESMO Constellation Management and System Administrator Users
- Improvements in the trend ephemeris to ensure that it accurately represents the ephemerides it is generated from

CCS 7.2

- Users will be able to quickly view the results of a saved analysis without re-running it.
- Users will be able to modify and update previously saved analyses
- Analyses shared with a user will be accessible from their Saved Analyses page

Save This Analysis

Note: This feature allows you to save the analysis results for future retrieval. The "Share With" field will email a link to each specified user with information on how to view this saved analysis.

Required fields are marked with an asterisk (*).

Update Saved Analysis?

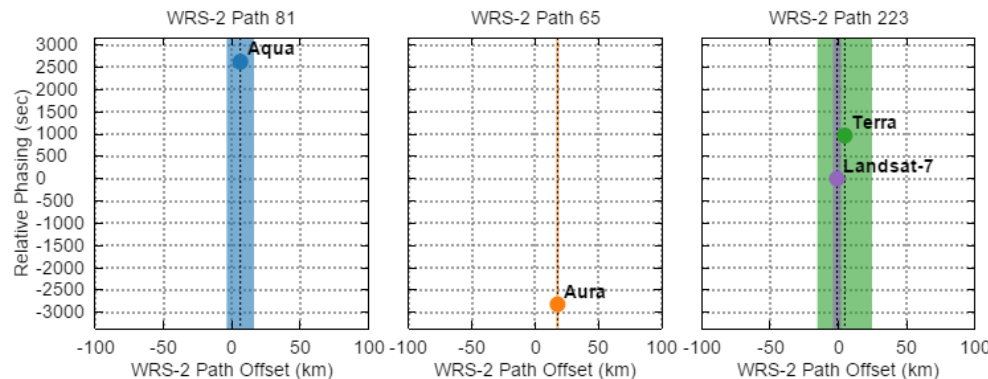
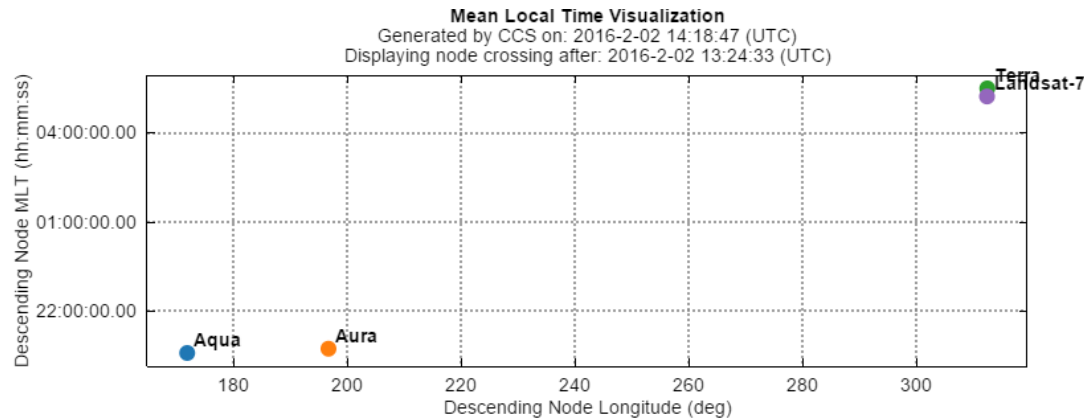
Saved Analysis Name*

Description*

Share With

CCS 7.2

- Input ephemerides included on saved plot images



Series Name	Ephemeris Files
Aqua	PM_EOSEPHM7_025_2016_01.e
Aura	CH_EOSEPHM8_362_2015_01.e
Terra	AM1_EOSEPHM7_362_2015_01.e
Landsat-7	L72016006LS7EPH.S00

CCS 7.2

- Addition of links to download the input ephemerides used in analysis on each Results page

Analysis Files

Mission	Ephemeris Name	Start Date	End Date
Aqua	PM_EOSEPHM1_336_2015_01.e	2015-12-02 00:00:00	2015-12-09 00:00:00
Aura	CH_EOSEPHM1_336_2015_01.e	2015-12-02 00:00:00	2015-12-09 00:00:00
Terra	AM1_EOSEPHM7_334_2015_01.e	2015-11-30 00:00:00	2016-01-18 00:00:00

Report Files

File Name	Created Date
Aqua_GTEControlBoxDataReport.txt	2015-12-11 08:35:09 UTC
Aqua_PhaseControlBoxDataReport.txt	2015-12-11 08:35:09 UTC
Aqua_ViolationDataReport.txt	2015-12-11 08:35:09 UTC
Aura_GTEControlBoxDataReport.txt	2015-12-11 08:35:09 UTC

CCS 7.2

- Ability to run the Ground Track Analysis Tool for multiple ephemerides/missions
- Option to specify the interpolation step size or use the ephemeris points in the Ad Hoc Tool

Use ephemeris points?

No

Yes

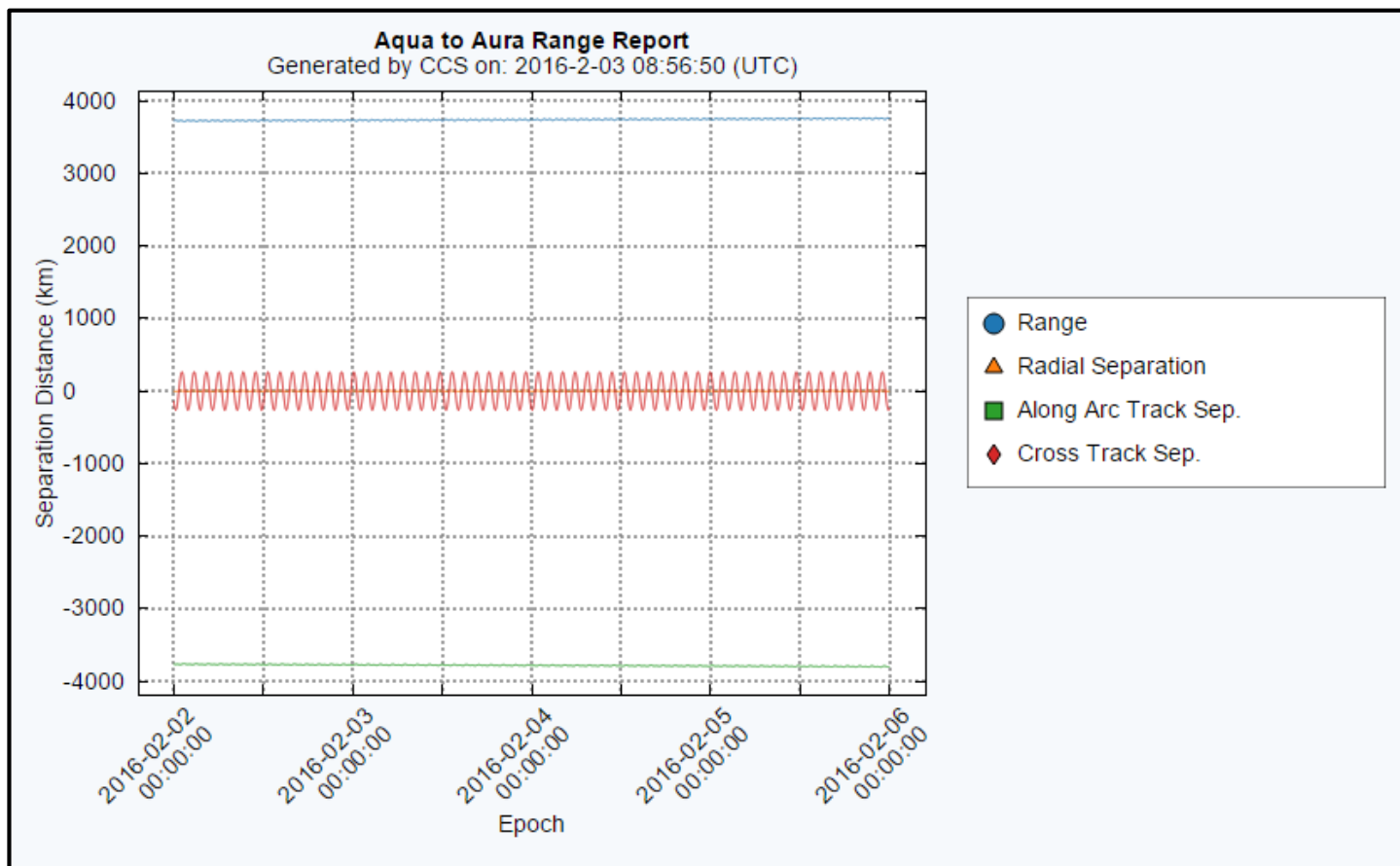
Note: Custom step sizes interpolate ephemeris data points. Interpolation may result in a less accurate representation of the orbit.

Define the step size for the analysis (in seconds)

60

CCS 7.2

- Constellation Close Approach Tool plot will include the radial separation, cross-track separation, in-track separation, and range



CCS 7.2

- New Ephemeris Conversion Utility converts a file in a CCS-supported ephemeris format uploaded by the user to a user-specified CCS-supported ephemeris format, which will then be available for download

Ephemeris Conversion

Required fields are marked with an asterisk (*).

Select an Ephemeris*

AM1_EOSEPHM...2016_01.e

Spacecraft*

Input File Format*

Output File Format*

Output Filename*

Ephemeris Conversion

Your converted ephemeris is ready for download.

Input Ephemeris: AM1_EOSEPHM1_030_2016_01.e

Spacecraft: Terra

Input File Format: STK 3.0 Ephemeris

Output File Format: Code500 Ephemeris

Output filename: Terra_Code500.ephem

CCS 7.3+

- Some major enhancements being considered for future CCS releases are:
 - Ability for users to define their own homepage including user-defined automated analyses
 - Automatic ephemeris selection when running a manual analysis where CCS chooses the most recent applicable ephemeris
 - Improvements in the speed of the website
- Any other suggestions?

CCS Security

- The CCS system administration team is currently planning several security and infrastructure improvements to all of the CCS operational and test systems
 - CCS EOC Ops
 - CCS BEOC Ops
 - CCS BEOC Test
- Improvements will better protect NASA systems hosting the CCS software and your mission's data located on these systems
- All changes will be communicated and coordinated with the Afternoon and Morning Constellation missions and the CCS user community beforehand

CCS Security

Security Enhancement	Schedule (approximate)	Plan
Annual password changes for mission accounts on the CCS FTP servers to comply with NASA password complexity requirements (12 characters, requiring lower and upper case letters, numbers, and special characters)	May/June 2016	Will be communicated in advance of changes. New passwords to be provided to missions through secure NASA NOMAD file transfer service
Use of RSA tokens for two-factor authentication for logging into the website	Summer 2016	Initial testing planned to begin in Spring 2016. Tokens will be mailed to all users and configured in advance of going operational. Instructions will be provided to users unfamiliar with RSA tokens.
Migration of CCS servers to a virtual machine (VM) environment	Fall 2016	Moving CCS software off of aging physical servers. Will evaluate combining the CCS website and content servers into a single server to simplify infrastructure. Our approach will attempt to limit impacts on established mission interfaces with CCS
Periodic password changes for user accounts on the website	TBD	Evaluating periodic website password changes as a feature of CCS 7.3

Questions?

- Thank you for your continued support!
- For all CCS communications please contact:
CCS_Support@ai-solutions.com